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STATEMENT OF ROBERT J. HALSTEAD ON BEHALF OF THE STATE OF NEVADA AGENCY FOR NUCLEAR PROJECTS REGARDING U.S. DEPARTMENT OF ENERGY'S DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR A GEOLOGIC REPOSITORY FOR THE DISPOSAL OF SPENT NUCLEAR FUEL AND HIGH-LEVEL RADIOACTIVE WASTE AT YUCCA MOUNTAIN, NEVADA

PRESENTED AT THE PUBLIC HEARING IN DENVER, COLORADO NOVEMBER 16, 1999

Transportation of spent nuclear fuel (SNF) and high-level radioactive waste (HLW) is inherently risky business. At previous hearings, our preliminary transportation comments have addressed specific deficiencies in DOE's Draft Environmental Impact Statement (DEIS) regarding shipment modes and routes, risks associated with legal weight truck (LWT) transport, vulnerability of shipments to human initiated events including terrorism and sabotage, and questions about the feasibility of heavy haul truck (HHT) transportation. These statements are available on the web at www.state.nv.us/nucwaste. At upcoming hearings we will address radiological health effects of routine transportation, radiological consequences of severe accidents, rail spur construction and operations, impacts on Native American lands and cultural resources, and social and economic impacts of public perception of transportation risks.

Today our focus is on the radiological characteristics of the SNF and HLW that DOE proposes to transport to the repository. The DEIS provides insufficient information on the radiological characteristics of SNF and HLW. The DEIS analysis of transportation radiological risks is inaccurate because it is based on incorrect assumptions about SNF cooling time . The DEIS fails to explicitly acknowledge the deadly nature of SNF and HLW.

1 **1. The DEIS provides insufficient information on the radiological characteristics of spent nuclear fuel (SNF) and high-level radioactive waste (HLW).** During the scoping process in 1995, Nevada recommended that the DEIS provide technical data on each type of SNF and HLW shipped to the repository, especially "key radiological characteristics: total radioactivity, radionuclide composition, surface dose rate, thermal output, and changes over time in each of these characteristics."

The DEIS identifies appropriate typical fuel types for pressurized-water reactor (PWR) and boiling water reactor (BWR) SNF, [p.A-14] typical HLW canister types, [Pp.A-38 to A-42] waste forms representative of eleven DOE SNF categories, [p.A-23] and commercial greater-than-Class-C wastes. [Pp.A-57 to A-58] The DEIS provides adequate information on the projected inventories, physical dimensions, and thermal characteristics for most, but not all, of these waste forms.

In sharp contrast, the DEIS provides insufficient and inconsistent technical data on the radiological characteristics of the designated "typical' waste forms. The DEIS inexplicably fails to provide such critical information as the total activity (in curies) and the surface dose rate (in rems per hour) for the "typical" PWR and BWR SNF assemblies, and for mixed-oxide (MOX) SNF fuel, as a function of initial enrichment, burnup history, and cooling time. Where the DEIS attempts to provide useful information on the radioactive material content of loaded rail casks, in Table J-14, the data on commercial SNF is either incorrect or in conflict with the data presented in Table A-8. The DEIS makes no attempt to provide comparable data on the radiological characteristics of truck casks loaded with various waste types.

2 **2. The DEIS analysis of transportation radiological risks is inaccurate because it is based on incorrect assumptions about SNF cooling time** .The DEIS makes incorrect assumptions about the "age"

2 continued or cooling time of the commercial SNF which DOE proposes to ship to the repository. The DEIS assumes that the typical PWR fuel will be 25.9 years old, and that the typical BWR fuel will be 27.2 years old. [p.A-14]The DEIS approach is deficient in two respects. First, the DEIS uses a specific value for SNF age rather than a bounding scenario approach. Second, the age, burnup, and initial enrichment values assumed in the DEIS, compared to actual expected characteristics, result in a significant understatement of radiological risks for extremely severe accidents, and successful terrorism incidents.

Cooling time is the single most important determinant of transportation radiological risk for the first hundred years after SNF is removed from a reactor. During this period, the radionuclides of primary concern are fission products, such as strontium-90 and cesium-137, which emit beta and gamma radiation and generate heat. DOE has previously stated the relationship between SNF age and radiation in the following table:

Radiation Characteristics of a Spent Fuel Assembly
(After 33,000 MWd/MTU burnup)

Age (Years)	Activity (curies/assembly)	Surface Dose Rate (rem/hour)
1	2,500,000	234,000
5	600,000	46,800
10	400,000	23,400
50	100,000	8,640
100	50,000	2,150

Source: U.S. DOE, Statement of Position, Waste Confidence Proceeding, April 15, 1980.

The DEIS should have used a bounding scenario approach, assuming SNF ages ranging from 5 years to 26 years, in order to accurately assess transportation radiological impacts. Past DOE program documents have assumed that 10 year-old SNF would be shipped to the repository, even though the average age of SNF in storage is closer to 20 years. DOE is considering high thermal loading scenarios that may require shipping 5-10 year-old fuel to the repository. The U.S. Nuclear Regulatory Commission (NRC) allows shipment of 5-year old SNF in currently licensed casks. Nuclear utilities have sought the option of shipping 5-year old SNF to the repository under their existing contracts with DOE.

In recognition of the extreme uncertainty about SNF age, the DEIS should have employed a bounding scenario approach. Assuming a range of SNF ages from 5 to 26 years would correctly increase the expected radiological impacts of severe accidents and terrorist attacks by at least a factor of three.

The DEIS should further have assumed 5 year –old SNF, coupled with higher burnup and initial enrichment values, when calculating the consequences of the maximum reasonably forseeable truck and rail accidents reported in Tables 6-11 and 6-12, and the sabotage impacts reported on page 6-34. The NRC recently approved repository shipments of 5 year-cooled SNF with up to 5 percent initial U-235 enrichment and 62,000 MWd/MTU burnup, as part of the 10CFR51 Final Rule Changes to Requirements for Environmental Review for Renewal of Nuclear Power Plant Operating Licenses. Accidents and incidents involving the hotter 5 year-old SNF could have radiological consequences five to ten times higher than those reported in the DEIS.

3 **3. The DEIS fails to explicitly acknowledge the deadly nature of spent nuclear fuel (SNF) and high-level radioactive waste (HLW).** Nevada's 1995 scoping comments recommended: "The radiological consequences of exposure and contamination associated with each reference fuel type should be presented in terms understandable to the general public, and these consequences should be presented in the Executive Summary as well as in the body of the draft EIS." DOE has chosen to ignore Nevada's recommendation.

The DEIS barely discusses the radiological hazards of SNF. The Executive summary states that spent nuclear fuel "consists mostly of uranium, and is usually intensely radioactive because it also contains a high level of radioactive nuclear fission products." [p. S-4] Volume 1 states that spent nuclear fuel" is intensely radioactive in comparison to nonirradiated fuel." [p.1-6] Except for identifying cesium-137 as a major source of SNF preclosure impacts and shielding requirements, [p.A-9] Appendices A, F, and J provide little specific information on the hazards of SNF.

How dangerous is spent nuclear fuel? Specifically, how dangerous to human health is DOE's designated "typical fuel type",[p.A-14] a 26 year-old PWR spent fuel assembly with 39,560 MWd/MTHM burnup and 3.69 percent U-235 initial enrichment? The DEIS fails to provide a technically accurate answer in language understandable to members of the affected public along the transportation corridors to Yucca Mountain.

Nevada's final comments will provide a detailed assessment of the full range of SNF and HLW irradiation and contamination consequences, expressed in the language of the health physics profession, complete with outputs from the ORIGEN2, RADTRAN, and RISKIND computer codes. Today we attempt to speak plainly, and conclude our preliminary analysis with the following observations.

The DEIS should have taken a conservative approach to radiological health effects by basing its evaluation on transportation 5 or 10 year-old SNF. DOE chose instead to evaluate 26 year-old SNF, which is considerably less dangerous. But even 26 year-old SNF is extremely dangerous. A person standing or sitting next to a single, unshielded 26 year-old SNF assembly for the amount of time that I have spoken this morning would receive a radiation exposure sufficient to cause death in 50 percent of the population. Extend the time to ten minutes, and death from classic radiation sickness replaces concern about latent cancer fatalities.

It works like this. Even after 26 years of cooling, the typical PWR assembly described in the DEIS contains 31,000 curies of cesium-137 and 21,000 curies of strontium-90, and is a powerful source of penetrating gamma and neutron radiation. Based on other DOE references, we estimate the surface dose rate to be <u>at least</u> 10,000 rem per hour, or about 166 rem per minute. A person standing or sitting next to an unshielded PWR assembly would receive <u>at least</u> 100 rem per minute.

How does the human body respond to such acute exposures? After one minute, mild symptoms of radiation sickness might appear, including vomiting and blood chemistry changes. After two minutes, vomiting and blood changes would definitely be expected, and cancer risk would approximately double. After six minutes, one could expect vomiting within three hours, followed by hair loss, and 50 percent probability of death within two months from hemorrhage or infection. After 10 minutes or more, vomiting would be expected within one hour, followed by severe blood changes, hemorrhage, infection, loss of hair, damage to bone marrow, and 80 to 90 percent probability of death within two months. The lucky few survivors would look forward to many months or even years of convalescence.